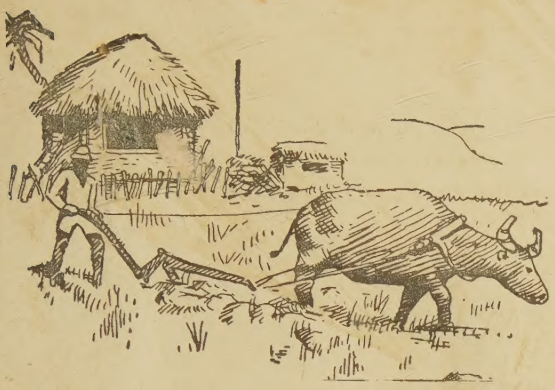
IMP. BUR.
13 JUL. 1926
ENTOM.

The Philippine Agriculturist and Forester



Vol. I November, 1911 No. 9

CONTENTS

	Page
The Effect of Shade on Abaca	161
Weather Report	167
College News	168
Report of a Trip to Sarangany by Dr. E. B. Copeland	169

Published by
THE STUDENT BODY OF THE COLLEGE OF AGRICULTURE
LOS BAÑOS, P. I.

TWO PESOS A YEAR TWENTY FIVE CENTAVOS A COPY

Foreign Subscription: 1.50 Dollars a year.

The Big Book Emporium of the Orient

Makes a specialty of handling *Books* and *Supplies* for schools and students. We carry everything you need at the lowest prices to be found anywhere

We can save you money
and you will get what you want

WRITE FOR CATALOG

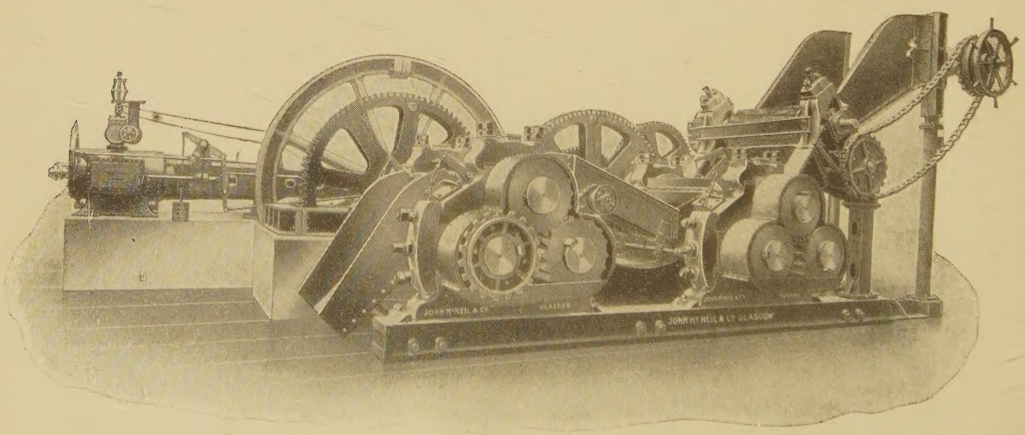
Philippine Education

34-ESCOLTA-34

FRED WILSON & CO.

ENGINEERS

Cane Grinding Plants of Every Description



Complete Factories—Engines and Boilers

41 URBIZTONDO -:- MANILA -:- SAN NICOLAS

FARM ENGINEERING CLASS

THE PHILIPPINE AGRICULTURIST AND FORESTER

VOL. I. NOVEMBER, 1911 No. 9

THE EFFECT OF SHADE ON THE ENVIRONMENT OF THE ABACA PLANT AND ON THE PLANT ITSELF

FELIPE CEVALLOS

The use of shade on the abaca plant is a common agricultural practice in many abaca growing districts in the Philippines, especially in Albay, Sorsogon, Leyte, and Camarines. Experience shows that shading the abaca plant may affect the crop favorably or unfavorably according to the local climatic conditions. In some localities the use of shade on this plant is necessary, because there are frequent droughts and baguios, while in other places, for example, in some parts of southern Mindanao, where there are plenty of rain, constant humidity of the atmosphere, and proper temperature of the air and of the soil throughout the year, the use of shade may be dispensed with altogether. Knowledge of the different influences of shade on the abaca plant is of great importance from the practical as well as the scientific standpoint. These various influences of shade upon the actual production of the crop constitute a broad subject, which takes up a great number of minor problems. But the whole problem can be solved only by great amount of experimental work and years of patient labor. To make a beginning on this work, attempts have been made at the College farm during the last year to determine some of the effects of shade on the environment of the plant and on the plant itself. This work was designed and carried out as a preliminary experiment to secure bases for further investigation of the subject. The experiments outlined in the following pages must, therefore, be considered as preliminary and the conclusions as almost tentative.

The divisions of the main subject are treated in the following order:—The plants and their protection; effect of the shade in conserving soil moisture; effect of the shade on evaporation; effect of the shade on soil and air temperatures; shading as a protection from baguios; effect of the shade on the color; general appearance and vitality of the plants during the drought of 1911; effect of the shade on the leaf exposure; effect of the shade on insect pests; effect of the shade on the development of a certain disease; effect of the shade on the production of suckers during the drought; effect of the shade on vegetative growth of the abaca plant during the drought.

OUTLINE OF THE EXPERIMENTS. GENERAL NOTES

The experiment on the effect of shade on the abaca plant began June 1911. The season of 1911 was exceptionally beneficial results of shading on account of the fact shat a severe drought and a strong baguio occurred during that time.

Three hundred abaca suckers of nearly the same size, height, and age were planted June 1911 in three separate plots treated under different conditions. One hundred suckers were planted in a densely shaded plot under coconut trees which are already bearing fruits; one hundred suckers, in a lightly shaded plot under young and thinly grown coconut trees; and the remaining one hundred suckers were planted in an

unshaded plot. The source of shade used in this experiment is not one usually to be recommended for abaca, but it satisfactorily answers the purpose of a preliminary research on the practice of shading.

Effect of Shade in Conserving Soil Moisture

Soil moisture determinations were made June 10, and August 25, which were after a period of quite abundant rainfall, and October 5, and November 16, which were during a period of pronounced drought. The soil taken for the determination was dried at 100° C. The composite samples showed the following percentages of moisture:—

SOIL MOISTURE DETERMINATION

	June 10	Aug. 25	Aver.	Oct. 20	Nov. 15	Aver
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Unshaded—In row	28.9	25.8	27.6	16.9	13.8	15.5
" Between row	29.8	26.2		17.3	14.2	
Lightly Shaded—In row	30.6	28.6	29.9	18.7	15.6	17.6
" " Between row	31.7	28.9		20.1	16.0	
Densely Shaded—In row	43.5	42.6	43.1	32.8	29.5	31.2
" " Between row	43.5	42.8		32.9	29.6	

The above figures showed that the soil taken from the densely shaded plot before and during the drought, contained 31-44 per cent of moisture more than that soil from the lightly shaded plot, and 36-51 per cent of moisture more than the sample from the unshaded plot. The table also showed that the soil between the row of each of the three plots was a little more moist than the soil in the row. This slight difference in the moisture content of the soil between the rows and that in the rows might be due to two factors; transpiration by the plants, and the different depth of cultivation of the soil. The latter may have been the more important for the reason that in order to avoid the destruction of the roots of the young abaca plants, the soil in the row was not cultivated as deeply as that between the row.

Effect of the Shade on Evaporation

The comparative evaporation from the three plots under experiment was determined by direct measurement. A number of graduated cylinders were set perfectly level in the ground in each plot; they were filled with water up to the highest marks. The amount of water evaporated was determined every day from October 20 to November 25 inclusive. There was no interference by rains because the whole period of observation was one of protracted drought. The records were as follows:—

DETERMINATION OF EVAPORATION

	Unshaded	Lightly Shaded	Densely Shaded
Oct. 20-22	2.9 cc.	0.8 cc.	0.4 cc.
" 24	2.5 "	0.5 "	0.3 "
" 26	3.2 "	1.9 "	0.4 "
" 28	3.3 "	1.0 "	0.5 "
" 30	3.4 "	1.4 "	0.3 "
Nov. 1	3.9 "	1.3 "	0.5 "
" 3	3.4 "	1.5 "	0.4 "
" 5	3.1 "	1.7 "	0.4 "
" 7	3.5 "	1.5 "	0.4 "
" 9	3.8 "	1.2 "	0.3 "
" 11	3.0 "	1.8 "	0.3 "
" 13	3.6 "	1.7 "	0.5 "
" 15	3.8 "	1.5 "	0.4 "
" 17	3.1 "	1.2 "	0.5 "
" 19	2.9 "	1.9 "	0.3 "
" 21	3.9 "	2.1 "	0.5 "
" 23	4.0 "	1.8 "	0.6 "
" 25	3.9 "	1.5 "	0.4 "
Total 18 days	61.2 "	26.1 "	7.4 "
Average per day	3.4 "	1.4 "	0.4 "

The table shows that the average daily evaporation of water from the densely shaded plot was 28.57 per cent of that from the lightly shaded plot and 11.76 per cent of that from the unshaded plot.

Although the apparatus used for this determination was far from perfect, the differences in the ascertained rates of evaporation in the several plots were so great that the possible inaccuracies are of no practical importance.

Effect of the Shade on Soil Temperature

Determinations on soil temperature were made during 22 days, from October 26 to November 16. A number of thermo-

meters were set in the ground at a depth of 8 cm. The upper end of each thermometer was fastened to a piece of wood fixed parallel to the ground; this piece of wood was supported at the ends by stakes driven firmly, so that the apparatus was practically immovable. The determinations were made three times daily,—at 6 A. M., 12 M., and 6 P. M. The records obtained were as follows:—

SOIL TEMPERATURE AT A DEPTH OF 8 CM. FROM THE SURFACE

DATE	DENSELY SHADED			LIGHTLY SHADED			UNSHADED		
	A.M.	M.	P.M.	A.M.	M.	P.M.	A.M.	M.	P.M.
	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C
Oct. 26...	24.8	28.4	27.9	23.8	29.5	27.8	21.1	30.0	25.4
" 27...	23.8	29.3	28.5	22.2	28.0	22.0	22.0	31.5	26.4
" 28...	23.9	29.0	26.9	23.0	29.2	26.5	22.2	31.2	25.4
" 29...	24.8	29.4	28.4	23.5	29.8	25.9	21.5	32.0	24.0
" 30...	24.6	28.5	27.5	23.2	29.8	27.0	22.5	32.3	26.5
" 31...	25.0	29.1	27.6	23.8	29.5	27.0	21.1	34.6	26.8
Nov. 1...	25.8	29.2	27.5	22.5	28.7	26.0	23.8	32.5	25.6
" 2...	24.0	28.6	27.5	22.8	29.0	26.8	21.9	32.5	25.8
" 3...	24.5	27.5	26.9	23.6	30.8	26.0	21.6	32.2	26.4
" 4...	24.2	27.0	25.8	23.4	29.5	26.4	22.0	30.0	25.4
" 5...	25.2	27.8	26.4	22.5	29.5	26.5	21.4	33.4	25.2
" 6...	24.2	28.5	26.2	23.2	28.4	25.4	21.9	33.0	25.0
" 7...	23.8	29.4	27.4	22.4	29.6	25.0	20.0	32.0	24.2
" 8...	23.6	29.9	27.5	21.4	28.7	24.4	21.5	32.5	25.0
" 9...	24.5	30.0	25.9	23.5	29.8	25.2	21.4	31.8	24.8
" 10...	25.6	28.6	26.6	23.6	29.0	26.0	22.3	34.5	24.6
" 11...	25.6	27.6	25.2	23.6	28.8	24.8	22.4	34.2	24.3
" 12...	24.8	29.2	26.8	23.2	30.5	25.0	21.5	36.4	24.0
" 13...	23.4	28.5	25.5	22.0	31.0	24.6	22.5	35.0	24.0
" 14...	23.6	29.4	26.0	22.5	30.2	24.2	20.9	33.3	24.2
" 15...	24.0	28.5	26.9	22.4	31.4	24.0	21.9	32.4	23.8
" 16...	23.9	29.1	25.4	22.5	30.2	24.5	22.6	31.9	22.5
Av. per day	24.4	28.7	26.7	22.9	29.6	25.8	21.8	32.6	25.0

This record shows that the soil temperature in the densely shaded plot in the morning and evening averaged 1.4° C higher than in the lightly shaded plot, and 2.3° C higher than in the unshaded plot; while at noon the soil temperature of the unshaded plot averaged 3.5° C higher than the average soil temperature of the shaded plots. The rise of temperature of the unshaded soil during the day was due primarily and at least chiefly to the direct action of the sun. The dryness of this soil made the increase of temperature easier because a dry soil is a better conductor of heat, and has less latent heat than does a moist soil. For both of these reasons, the dry soil lost its heat much more rapidly than did the moist soil of the shaded plots. These factors, aided in some measure by the stiller air, are responsible for the higher temperature of the soil in the shaded plots at night and in the morning.

EFFECT OF THE SHADE ON THE TEMPERATURE OF THE AIR

Observations on the temperature of the air were made during the same period and at the same hours as those of the soil temperature. The records are shown in the following table:

RECORD OF THE TEMPERATURE OF THE AIR

DATE	DENSELY SHADED			LIGHTLY SHADED			UNSHADED		
	A.M.	M.	P.M.	A.M.	M.	P.M.	A.M.	M.	P.M.
	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C	DEG C
Oct. 25...	22.8	27.1	26.9	20.5	32.5	26.5	19.3	33.4	24.6
" 26...	22.8	28.5	27.1	20.0	33.5	26.0	19.2	36.2	23.5
" 27...	21.5	29.4	26.2	19.0	35.4	25.8	18.5	36.8	23.4
" 28...	21.5	30.0	26.9	19.2	34.8	25.5	18.8	35.0	24.4
" 29...	21.4	30.1	24.9	19.0	30.0	24.8	17.8	33.2	24.3
" 30...	21.8	29.4	25.5	19.8	31.2	26.1	19.0	35.2	23.0
" 31...	20.9	28.7	25.8	21.0	32.8	24.8	20.0	34.8	25.0
Nov. 1...	24.5	27.0	26.2	18.2	31.5	24.4	17.9	37.8	25.0
" 2...	22.6	28.9	26.0	18.5	32.8	26.9	18.3	34.8	23.5
" 3...	23.2	29.9	24.9	20.3	32.8	23.2	19.0	33.2	20.1
" 4...	24.8	28.6	26.2	20.2	31.2	24.8	18.8	34.6	20.8
" 5...	22.6	27.8	25.1	20.0	35.8	24.2	18.2	37.8	23.0
" 6...	21.8	29.1	26.8	19.9	34.5	25.2	18.9	37.0	24.0
" 7...	22.7	28.6	27.0	19.5	34.8	22.0	18.2	36.1	22.5
" 8...	21.8	28.6	26.5	19.2	31.2	21.8	19.8	35.2	22.8
" 9...	22.4	29.4	25.4	19.0	32.1	22.9	18.3	32.2	20.9
" 10...	23.4	30.0	24.2	18.6	32.8	26.7	18.2	34.5	26.1
" 11...	21.8	28.5	25.2	20.2	31.8	26.2	19.1	33.3	25.0
" 12...	22.5	27.5	26.5	21.2	31.5	22.9	18.9	92.4	22.6
" 13...	20.4	29.4	27.6	19.5	32.8	25.5	19.8	35.8	24.8
" 14...	21.3	29.4	27.0	19.2	31.5	24.5	19.5	34.8	23.4
" 15...	25.8	29.8	26.0	19.0	32.4	28.0	18.6	33.6	23.6
" 16...	24.5	30.0	27.6	19.0	36.2	27.6	19.0	37.7	25.8
" 17...	23.8	28.8	26.7	21.2	32.2	24.4	20.5	34.4	24.4
" 18...	22.5	29.9	25.0	19.5	32.2	28.5	20.1	34.8	23.6
Av. per day	23.5	28.9	27.1	19.5	32.8	25.0	19.0	35.0	24.0

The record showed that the air in the densely shaded plot in the morning and evening averaged 3.1° C warmer than in the lightly shaded plot, and 3.9° warmer than in the unshaded plot; while at noon it averaged 3.9° C cooler than the air in the lightly shaded plot, and 6.1° C cooler than in the unshaded plot. The net effect then of shade was to make the temperature of the air much more constant.

INDIRECT EFFECTS OF SHADING

In the short discussion which has already been given to the influence of shade upon

various factors of the environment of the abaca, it may seem to have been assumed that this action was altogether direct. This is not however the case. The shade, as such, tends to keep the temperature of the soil and of the air from any great increase during the day, and in this way lessens the evaporation from the soil or from the plants. This in turn keeps the soil moisture, and the high moisture content of the soil then contributes in its turn to make the temperature of both air and soil, and the humidity of the air, more constant still. The trees which provide the shade tend to produce the same results in an altogether different way in that they act as a cloud might, confining beneath them a layer of air and protecting this layer in large measure, by air currents from without. How much of the differences observed between the soil and air in the shade and in the open sunshine is due to the shade producing effect of the trees, and how much of it is added to this rather mechanical action, I am unable to say.

The Practice of Shading Protects the Abaca Plant from Baguio

A strong baguio which occurred during the month of July 1911 did a considerable damage to the young abaca plants under experiment. The following table will show the number of leaves destroyed on each plot:

Densely Shaded Plot: 204. Lightly Shaded Plot: 350. Unshaded Plot: 411.

The damage done by the baguio to the plants grown in the densely shaded plot was 58.1 per cent of that to the lightly shaded plants, and only 49.6 per cent of that to the unshaded plants. The damage done by this baguio to the plants grown both in the lightly shaded and densely shaded plants would average 66.9 per cent as much as the damage done by it to the plants in the unshaded plants. It is seen from this record that the practice of shading abaca protects it from severe injury of baguios.

Where abaca is shaded for this reason, the following observations are pertinent:— the shade trees chosen should be such as are not easily broken by baguios: they must be long-lived trees; and they must be trees which do not prevent the passage of the proper amount of light for the photosynthetic work of the abaca leaves; a systematic plan of planting should be carefully followed. The profit derived from shade trees is not measured wholly by the protecting service against baguios, and the yield of timber, fruits, etc., but they serve in many cases to prevent harmful weathering and erosion of the soil.

Some abaca growers in Albay Province plant several kinds of shade trees on their abaca plantations and the practice of mixing seems generally to give good results. The trees which are usually grown together in those localities are pili, jack-fruit, bread-fruit, narra, camagon, anonang, and dapdap, and sometimes coconut. The great advantage of using the first three trees and the coconut is based upon the fact that they can supply the farmers with fruits and nuts. A number of these trees which are mentioned above are hardy and long-lived, especially pili, narra, and camagon. The dapdap is a fairly good shade tree to be used on abaca plantations for these reasons: it is easily grown; it grows very rapidly and therefore it can be used once to protect the young plants; it is a leguminous plant, consequently it can furnish the plants with nitrogenous material, and its leaves, branches and trunks decay very rapidly. Some objections to its use, are that it is not hardy and long-lived, and that sometimes during dry season it sheds its leaves.

Effect of the Shade on the Appearance and Vitality of Plants

A peculiar characteristic appearance of the plants grown in the lightly shaded and unshaded plots developed during the

drought. As the dry season advanced, the leaves gradually turned yellowish, and then became thicker, shorter, and narrower than the leaves of plants under the old coconuts. These plants in the unshaded plot grew very much more slowly than those plants grown in the densely shaded plot, and so became stunted. Parts of their leaves even turning brownish-black as though scorched; while the plants of the densely shaded plot kept green throughout. If this yellowing and browning go far enough, the plant dies. The following table shows how many plants in each plot were killed in this way: Densely Shaded Plot: 0. Lightly Shaded Plot: 6. Unshaded Plot: 15.

Effect of the Shade on the Leaf Exposure

Observations on the effect of the shade upon leaf exposure of abaca were made during the period of pronounced drought. The determinations were carried out three times a day:—at 6 A.M.; at 12 M; and at 6 P.M. The record for three days follows:

DETERMINATION ON LEAF EXPOSURE

Date		Densely Shaded Plot			Lightly Shaded Plot			Unshaded Plot		
		A.M.	M.	P.M.	A.M.	M.	P.M.	A.M.	M.	P.M.
		Width	Width	Width	Width	Width	Width	Width	Width	Width
		Leaf in cm	in cm	in cm	in cm	in cm	in cm	in cm	in cm	in cm
	I	16.5	13.5	16.5	16.0	8.6	15.5	16.5	7.5	16.0
	II	17.5	14.2	17.5	17.9	9.5	17.0	17.5	8.0	16.5
Nov 26	III	13.8	11.4	13.8	14.0	5.8	13.6	13.8	4.2	13.0
	IV	20.5	17.8	20.5	20.5	9.0	19.8	20.5	9.0	19.0
	I	16.5	14.0	16.5	16.0	9.5	15.0	16.5	7.8	15.0
	II	17.5	14.8	17.5	17.9	9.8	16.7	17.5	8.8	16.5
Nov 27	III	13.8	10.0	13.8	14.0	5.6	13.5	13.8	4.6	13.8
	IV	20.5	17.0	20.5	20.5	10.5	19.0	20.5	9.3	18.9
	I	16.5	12.5	16.5	16.0	9.8	15.2	16.5	8.0	15.0
	II	17.5	13.0	17.5	17.9	11.2	16.0	17.5	9.0	15.6
Nov 28	III	13.8	11.2	13.8	14.0	5.6	13.0	13.8	4.5	12.2
	IV	20.5	15.9	20.5	20.5	13.0	19.5	20.5	9.0	19.0

I have not made a physiological or anatomical study of movement shown by this table. Whatever the details may be, it is essentially the same in cause and in results as the daily folding downward of the leaflets in the coconuts. At least under the extreme conditions existing when these measurements were made, the decrease of exposure is greater for the abaca than for the coconut. The width of the leaf measured directly to margin was reduced at noon, and an average of 43% in full sunshine, 52% in partial shade, and 80% in full shade of the width in the early morning. This decrease in area of exposure to illumination is of great and evident importance to the plant as a check to excessive transpiration. It is probably of great further value as a protection against injury by too intense insolutation, but it is not to be forgotten that the decrease in exposure must work a corresponding decrease in photosynthetic activity.

Effect of Shade on Pests and Diseases

An insect known as the banana leaf raller (Erionatha Linn) belonging to the family Hesperiidae was found to attack the young abaca. This insect attacked the unshaded and shaded plants as shown by the following table in which the figures are the number of leaves.

OBSERVATIONS ON INSECT PEST

Densely Shaded Plot	Lightly Shaded Plot	Unshaded Plot
(Number of leaves destroyed)		
64	50	48

In some places in Albay Province the same insect pest has been found to attack the young abaca plants, especially those plants which are grown under dense shade. The abaca growers do not pay much attention to the pest, because the injury it does is too slight.

In certain localities in Albay, the disease known in Bicol as "amasog" is commonly found in abaca grown in dense shade. This disease is supposed to be caused by a fungus. The roots of the abaca plant are the parts attacked. The first indication of the disease is the appearance of

small brown patches on the roots, and later turn brownish black throughout. This disease also is disregarded by the planters; but a study of its prevalence and effects is necessary before its real importance can be estimated.

Effect of the Shade on the Production of Suckers

Observations on the production of suckers have also been made with the following result: The figures are the number of suckers in each plot.

Observation on the Production of Suckers

Densely Shaded Plot	Lightly Shaded Plot	Unshaded Plot
(Number of Suckers)		
259	178	169

The plants grown in the densely shaded plot produced 81 suckers more than those plants in the lightly shaded plot, and 90 suckers more than those in the unshaded plot. This is merely one expression of the greater vigor of the shaded plants, which appears more conspicuously when the growth of the leaves is studied.

Effect of the Shade on Vegetative Growth of the Abaca Plant During the Drought

During the period covered by the following table, that is, from August 6 to March, a record was kept of the growth of all of the growing leaves of 50 plants on each of the three plots, with one exception, that is, measurements were made at intervals of one week. There were usually four growing leaves on each plant, but the table represents for each plant only the growth of the most vigorously growing leaf. These measurements were begun as soon as germination of the suckers had reached the point where it was possible to select a number of plants from the field with confidence that the plants so selected for comparison were uniform at the start.

The testimony given by the observations from which this table has been compiled, is uniform in a degree, which could hardly be expected, but which can be accounted for by remembering that the figures compared are averages of measurements of fifty individual plants, and that an exhibition of individual variability is in this way excluded. During the entire period covered by this table, there was no single week in which the average growth on the three plots was not proportionate to the intensity of the shade.

CONCLUSION.

Under all conditions which have existed during this experiment the conclusion can be drawn, without any possibility of doubt, that shade is beneficial to abaca. The difference between the plants in the different plots is so great that this conclusion can fairly be made stronger, that is to say, that shade is indispensable to the successful culture of this plant. But it must be borne in mind that these conditions were very exceptional for this locality, and that the locality under normal conditions is one in which no considerable abaca industry has developed. From start to finish the season was unprecedentedly dry. The term of these measurements also included a severe typhoon, but in this respect the season may not have been worse than might reasonably have been expected. The conclusions must not be generalized nor regarded as having any necessary application to periods or localities of greater and more constant rainfall. Work already done in this college, in which I have had a part, has shown that under different conditions, exactly the opposite conclusions might be drawn. During a period of comparatively frequent showers and constant adequate moisture in the soil, it was found that the

Growth of the Abaca Plant.

Densely Shaded Plot.

Date	Plant No 1	Plant No 2	Plant No 3	Plant No 4	Plant No 5	Plant No 6	Plant No 7	Plant No 8	Plant No 9	Plant No 10	Plant No 11	Plant No 12	Plant No 13	Plant No 14	Plant No 15	Plant No 16	Plant No 17	Plant No 18	Plant No 19	Plant No 20	Plant No 21	Plant No 22	Plant No 23	Plant No 24	Plant No 25	Plant No 26	Plant No 27	Plant No 28	Plant No 29	Plant No 30	Plant No 31	Plant No 32	Plant No 33	Plant No 34	Plant No 35	Plant No 36	Plant No 37	Plant No 38	Plant No 39	Plant No 40	Plant No 41	Plant No 42	Plant No 43	Plant No 44	Plant No 45	Plant No 46	Plant No 47	Plant No 48	Plant No 49	Plant No 50	Average Weekly Growth
	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm
Aug 6-12	29 3	24 4	26 6	28 5	31 5	45 8	34 1	35 8	29 4	31 9	42 2	20 1	11 8	20 1	35 1	31 2	22 1	35 1	20 5	21 8	35 1	29 9	41 2	30 5	27 8	26 0	22 4	28 9	17 5	15 8	23 8	31 5	7 8	16 4	12 2	19 5	14 5	21 5	18 9	15 5	18 9	25 7	24 3	21 8	18 2	27 6	20 5	25 1	13 2	15 1	25 4
" 19	39 0	32 1	37 5	36 0	33 6	48 3	43 6	36 1	36 6	34 8	43 7	43 7	17 8	22 2	36 1	32 6	24 8	36 3	25 4	35 8	36 7	35 8	46 7	41 6	29 1	36 1	25 2	33 8	22 8	24 6	27 8	32 8	24 5	18 5	16 6	29 9	20 9	28 5	25 9	22 3	35 6	25 9	25 5	24 5	19 5	31 9	25,3	27 0	26 6	29 5	30 9
" 26	48 3	36 2	38 9	38 0	34 4	49 9	46 3	44 3	40 7	36 6	46 6	46 7	27 8	24 8	37 4	33 8	26 3	40 1	35 6	36 1	38 9	38 6	47 8	43 8	31 5	38 2	27 0	36 3	31 0	28 3	31 4	40 5	26 2	27 3	29 8	34 5	28 5	34 0	29 5	28 0	36 1	31 0	32 0	25 7	20 8	42 9	27 7	32 7	36 1	29 9	35 1
Sept. 2	49 4	39 8	40 1	40 1	40 8	50 3	46 5	46 3	38 3	37 8	47 3	47 6	29 6	26 8	38 7	34 8	31 2	45 8	40 0	37 8	40 1	40 6	50 1	46 3	36 7	40 1	31 8	37 5	32 1	34 2	31 6	43 3	27 5	31 6	29 9	35 9	31 5	40 1	32 2	35 5	37 0	32 6	33 7	26 8	21 5	45 6	31 8	35 8	39 4	34 5	37 9
" 9	50 1	38 3	42 3	41 5	45 5	54 8	48 2	46 0	44 8	37 9	48 8	50 6	33 6	27 6	40 4	36 5	36 7	46 7	48 7	49 2	43 3	43 3	52 6	47 2	38 6	42 1	33 6	37 9	33 4	35 5	35 8	44 5	29 8	34 5	35 5	38 7	35 7	45 5	35 6	40 5	40 2	35 6	34 9	27 9	23 3	46 3	35 5	34 6	41 5	34 6	40 9
" 16	51 0	40 0	43 2	43 6	48 3	59 6	50 6	48 7	44 2	40 2	49 5	54 7	34 5	30 5	41 9	40 0	38 2	49 5	50 2	48.9	44.6	44.6	53.8	48.5	39.8	42 0	35.5	38 2	34.6	36.8	43 5	45 2	35 5	35 2	36 2	10 8	39 8	50 0	38 7	42 6	42 1	39 7	36 7	29 7	26 7	49 7	37 1	38 7	45 6	35 6	42 2
" 23	50 1	44 1	51 6	48 0	49 1	62 2	52 2	49 3	50 1	43 2	52 8	56 5	36 7	32 8	44 2	42.1	45 6	54 6	55 6	52.6	46.7	47.6	54.7	49.9	41.3	43.8	36.4	39.8	34.8	40.2	44 9	45 8	38 9	35 8	38 0	43 3	44 0	54 3	42 2	43 6	43 0	42 3	42 3	31 8	28 9	51 1	38 9	39 9	48 9	36 7	45 0
" 30	54 8	50 4	59 8	58 1	55 8	65 4	55 3	56 7	54 2	50 7	54 5	59 4	38 2	35 8	50 2	46 5	47 8	61 7	59 6	53.7	48.8	48.3	56.5	56.5	48.9	50.3	38.8	41.5	36.6	43.3	46 3	49 6	40 8	40 4	41 2	48 0	50 5	56 8	45 9	43 6	49 9	46 2	48 3	38 2	31 5	52 4	41 7	43 2	49 5	40 1	49 3
Oct 7	60 1	62 1	69 3	62 9	61 3	68 2	59 8	58 3	56 3	51 6	56 7	61 8	39 4	40 9	52 6	48 3	48 3	65 8	54.8	50.2	49.5	57.6	58.8	50.1	50.3	38.1	60.1	50.8	44.0	47 7	52 5	43 3	46 6	45 2	43 6	53 4	58.6	54 5	48 4	51 8	48 9	56 7	49 3	34 6	54 6	42 1	44 3	53 3	45 9	52 3
" 14	61 3	63 0	70 1	63 5	62 3	68 3	66 1	64 1	56 7	52 3	39 9	70 2	40 2	44 6	53 8	50 2	48 3	62 7	69 9	56.6	60.4	53.4	57.8	52.0	54.3	52.8	38.1	65.8	52.3	45.5	49 8	56 9	48 8	48 4	46 8	48 2	56 6	61 8	58 0	49 7	60 5	52 6	58 9	49 0	39 8	59 5	40 3	45 6	58 8	51 8	54 7
" 21	69 1	63 1	71 3	42 1	65 1	61 2	67 7	70.5	61.2	54 4	48 6	71 7	44 3	46 3	54 5	50 2	49 4	70 1	71 2	58.8	61.2	56.7	58.0	48.3	50.4	51.0	37.3	63.5	53.2	47.0	50.7	61 2	49 8	54 8	49 5	40 3	56 1	63 9	61 4	52 6	54.6	56 0	61 2	48 1	44 9	60 3	38 6	46 3	61 2	60 5	55 8
" 28	70 1	65 4	70 1	45 1	58 1	61 6	67 8	60.1	65.2	56 7	42 7	61 2	43 5	50 9	49 5	5 3	45 6	65 3	64 4	57.3	63.5	57.8	65.4	38.3	49.2	60.1	35.8	63.1	49.3	42.3	43.1	64 5	51 6	56 3	51 8	40 0	52 1	64 1	51 3	53 1	50 0	54 1	62 3	50.2	46 7	58 8	37.5	49.3	62 4	62 3	54 7
Nov 4	40 1	48 3	55 3	43 2	57 3	39 9	58 3	62.1	60 1	50 7	52 8	60 3	42 0	51 2	43 2		41 6	60 0	60 1	50.5	50.2	48.4	50.3	37.1	49.0	62.3	30.2	36.5	40.5	38.2	40.0	51 2	40 4	43 1	50 5	39 0	53 3	50 6	50 0	58 9	50 0	52 0	58 6	40 5	41 5	50 1	35.6	43.4	54 5	59 4	48 4
" 11	35 2	43 7	36 3	40 3	50 8	36 5	58 1	40.5	58.2	48 9	43 3	50 1	40 6	48 2	39 6		40 1	55 6	60 0	48.2	52.4	49.3	50.0	35.5	40.4	54.1	30 0	33.8	38.9	30.8	38.5	48 3	40 0	40 7	50 0	39 0	48 1	50 5	48 2	51 0	39 1	48 1	50 0	40 0	38.4	43.7	32.3	40.0	50 6	50 2	44 2
" 18	24 4	43 8	36 1	37 1	48 6	34 1	40 8	30.3	50.1	42 1	41 1	48 2	38 2	37 1	28 7		36 8	48 8	51 2	39.3	48.6	40.5	43.2	30.2	32.6	38.1	28.5	30.2	37.9	29.3	38.0	40.3	35 7	39 4	38 4	30 2	40.2	48.2	30.5	49 5	35 5	39 7	48 5	38 2	35 3	40 1	30.1	38.2	48 9	45 0	38 6
" 25	22 7	35 4	36 5	30 6	40 1	33 3	26 7	28 7	40.0	26 7	38 2	38 0	31 9	30 4	25 6		30 2	46 2	40 5	35.6	41.7	30.1	40.5	30.0	31.1	32.8	25.6	30.1	37.6	29 1	30 8	38.5	35.0	29 5	30 0	28 1	38.5	30.0	28.6	45 4	34 2	38 8	40 2	36 6	31 1	38 2	25.5	35.6	40 0	46 2	34 6
Dec 2	22 7	35 3	34 1	30 5	28 0	33 6	24 8	24.3	32.0	24 9	25 4	29.5	25.8	27 0	23 5		25 5	35 6	30 3	31.1	32.0	28.7	35.1	25.6	26.8	30.9	25.5	29.8	37 5	28.8	29.5	30.0	32.1	24 6	29 5	25 7	30.7	29.0	24.4	38 6	34 0	38 8	38 0	35 4	30 1	32 3	24.9	31.0	40 0	43 4	30 1
" 9	18 8	24 8	34 6	29 0	25 9	40 0	24 6	23.1	30.4	24 5	20 0	25.8	24.1	26 0	22 6		25 5	30 0	28 7	30.1	30.2	21.0	32.1	22.4	23.7	28.5	23.4	28.7	35.8	27.5	29.0	35.9	31.0	29 5	29.0	24.8	29.6	28.8	22.3	35 6	33 4	28 5	35 9	36 0	28 7	30.1	24.6	29.6	45 8	40 0	28 7
" 16	25 8	38.7	40 4	38 2	38 7	45 0	30 9	24.8	35.8	38 2	42 1	34 3	36 6	40 9	30 1		23 6	39 0	29 1	35.2	36.5	32.8	39.5	30.8	32.6	35.6	38.2	32.1	40.1	38.7	32.6	55.8	38.0	56.5	35 8	31.0	38.5	38.5	28.5	32 0	40 6	30 2	40 6	41.8	39.5	38.7	58.2	38.2	55 6	45 8	37 5
" 23	50 2	60 2	65 1	70 1	60 1	65 3	68 0	58.2	60.2	58 3	70 3	48 2	56 8	59 6	54 2		30 2	51 2	44 6	42.6	53.6	44.2	42.0	37.5	39.9	50.1	60.1	62.1	58.2	48.6	68.5	43.6	60.1	66.3	40.1	45 1	60.1	60.5	36.3	38 5	50 2	41 5	48 5	58.3	58.7	60.0	49.6	60.1	68 5	48 6	53 8
Jan 6	116 6	130 5	138 8	148 6	131 0	135 8	140 8	120.1	132.8	130 8	148 4	101 3	121 5	126 3	120 4		98 5	125 6	93 3	92.5	118.8	98.3	86.9	82.3	86.6	108.0	125.8	128.5	120.1	108.4	141.2	103.8	125.6	107.8	85.6	99.3	129.7	128.6	72.8	100.9	108 5	85 6	134 5	119.9	122.6	125.8	100.2	128.5	130 8	109 8	116 4
" 13	62 4	70 8	69 9	71 4	70 0	69 5	69 8	65 6	68 8	68 5	78 3	57 5	63 5	64 5	64 5		51 6	68 9	51 0	47.6	60.1	52.4	49.2	48.5	46.8	56.3	65.8	66.8	62.3	58.4	74.5	64.5	63.8	50.2	45.9	54.4	68.8	70.2	42.5	53.7	59 5	44 7	54.8	62.4	66.7	65.9	71.5	68.5	75 4	56 1	61 5
" 20	64 8	70.9	72 7	71 6	70 2	69 8	68 9	66 2	69 5	69 0	80 2	59 6	65 8	73 1	65 9		56 3	69 8	52 5	48.3	62.2	53.6	51.6	43.8	46.9	58.5	65.9	67.2	63.4	59.3	75.0	65.4	64.7	55.6	47.6	56.3	71.5	71.5	46.9	54.8	62 2	45 9	56 3	65 0	67 8	66.5	72.6	69.5	75 9	56 4	65 1
" 27	66 9	72 8	74 3	74 5	72 3	71 0	70 8	69 8	70 8	71 4	83 3	61 7	68 8	74 5	68 3		58 8	70 8	54 6	52.1	64.2	58.3	56.0	45.7	48.9	61.8	67.8	69.1	65.5	63.4	76.6	67.8	68.0	58 0	49.0	58.9	73 0	78 9	50.9	64.8	68 8	55.4	63 4	69 7	69.7	70.1	79.9	75.2	76.8	57.6	65.5
Feb 3	67.0	72.9	75.4	74.0	70.5	60 5	60 0	60 1	70 9	71 5	89 9	62 8	69.7	74.6	69 2		59 9	71 0	56 8	52.2	66.1	60.3	57.8	46.8	50.1	62.8	69.7	70.2	66.7	64.5	76.7	68.4	69.5	59.8	52.3	60.1	74.1	79.8	52.8	65.0	69.2	60.5	68.5	74.5	73.3	74.3	83.4	76.0	77.8	60.5	67.1
" 10	68 2	73.4	76.5	71.0	70.6	65 0	60 1	68 0	70 8	74 0	89 8	62 0	69 8	60.4	61 5		59 0	76 0	56 8	50.0	68.5	65.4	65.8	50.9	54.8	65.4	69.8	71.2	67.8	65.8	76.0	69.2	71.2	65.4	56.4	65.4	74.0	79.8	54.6	65.4	68 0	65.4	69.9	74.7	74.0	70.0	81.0	77.1	75.4	61.2	67.8
" 17	70 0	74 5	76 0	72.0	71 5	68 5	65 8	69 8	71 9	75 8	85 9	63 4	72.1	68 8	65 4		63 5	76 5	59 8	52.8	69.0	66.5	68.9	55.8	59.8	68.5	74.4	75.6	70.1	66.5	76.0	69.0	72.4	67.4	57.6	66.5	75.6	78.6	61.0	68.9	71.5	66.5	75.4	75.0	75.0	71.8	80.5	78.0	76.5	68.9	69 0

Growth of the Abaca Plant.

Lightly Shaded Plot.

Date	Plant No 1	Plant No 2	Plant No 3	Plant No 4	Plant No 5	Plant No 6	Plant No 7	Plant No 8	Plant No 9	Plant No 10	Plant No 11	Plant No 12	Plant No 13	Plant No 14	Plant No 15	Plant No 16	Plant No 17	Plant No 18	Plant No 19	Plant No 20	Plant No 21	Plant No 22	Plant No 23	Plant No 24	Plant No 25	Plant No 26	Plant No 27	Plant No 28	Plant No 29	Plant No 30	Plant No 31	Plant No 32	Plant No 33	Plant No 34	Plant No 35	Plant No 36	Plant No 37	Plant No 38	Plant No 39	Plant No 40	Plant No 41	Plant No 42	Plant No 43	Plant No 44	Plant No 45	Plant No 46	Plant No 47	Plant No 48	Plant No 49	Plant No 50	Average Weekly Growth
	cm	cm	cm	cm.	cm	cm	cm	cm	cm	cm.	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm
Aug 6-12	26 0	23.5	25.9	19.1	18.2	38.6	29.8	19.9	20.1	25.9	30.1	15.8	10.2	17.8	18.8	28 3	19.1	25.9	30.8	15.8	31.0	25.2	34.5	29.3	28.3	26.1	17.8	20 5	13.8	22.6	21.2	26.2	6.8	10.5	9.0	11.6	12.9	20.2	15.3	13.2	14.1	21.5	18.8	13.6	12.5	21.1	13.4	16.3	8.8	9.1	20.0
" 19	36 1	28.1	36.1	26.2	26.8	44.8	38.8	26.7	34.6	30.8	40.2	30.4	16.3	19.9	31.0	30 1	20.5	39.1	39.6	30.9	34.2	33.5	45.4	40.2	29.5	35.6	19.8	25.6	16.9	25.9	26.7	28.3	23.4	12 3	14.5	26.1	18.3	26.7	19.8	19.4	29.1	23.3	19.5	15.8	14.6	28.5	16.5	25.4	21.3	18.4	26.8
" 26	38 2	34 1	37 1	27 4	38 3	37 9	40 1	26 8	35 2	34 5	41 5	45 8	26 1	20 1	35 4	3 4	22 2	41 2	49 8	33 0	35 6	36 7	46 3	41 9	31.0	36.8	25.8	26.7	25.6	27.8	30.5	30.5	25.8	20.6	25.4	27.3	25.8	32.7	26.3	26.3	29 9	25.8	22 6	16.6	16.3	37.6	19.8	30.0	26.7	19 5	29.9
Sept 2	40 1	38.5	38.2	40.8	39.4	47.8	40.2	27.5	36.5	35.4	45.3	48.9	29.3	32 3	36.5	33.6	30.6	45.5	52.6	34.1	38.7	38.8	47.8	43.8	35.3	39.5	30.0	28.0	26.7	27.3	31.8	33.1	30.4	25.8	25.9	34.8	29.9	38.2	30.4	34.2	31.2	30.0	25.5	18.3	18.3	39.6	22.1	36.1	37.8	26.5	35.6
" 9	42 1	40.1	39.2	45.6	38.9	48.3	41.7	37.2	37.8	36.2	46.2	48.9	32.4	34.3	37.8	34.1	30.8	46.7	55.5	36.2	40.0	40.1	50.6	44.9	37.8	40.1	31.2	30.5	28.3	30.5	33.1	36.2	33.6	30.4	26.6	36.3	31.4	40.2	33.1	25.5	36.6	30.9	39.3	24.4	25.8	41.6	25.8	40.6	39.9	30.1	36.9
" 16	42 0	50.2	43.1	46.3	50.1	33.2	42.4	40.1	39.4	38.4	46.8	52.3	33.8	42.2	40.1	38.5	34.1	49.7	56.4	39.9	42.3	44.6	49.0	45.8	39.9	41.8	34 2	38.2	30.1	31.5	34.4	42.2	36.5	32.1	35.8	38.2	35.6	44.3	36.2	36.6	37.8	34 8	41.5	26.5	27.9	42.0	29.6	42.3	46.5	39.8	39.9
" 23	43 8	51.9	59.3	48.1	51.2	56.1	48.3	43.4	42.3	42.1	48.9	56.3	35.6	43.2	42.2	40.3	35.6	54.0	57.2	44.2	45.6	50.3	52.1	50.9	40.8	42.8	34 6	40.1	31.2	32.5	36.6	44.5	37.8	36.5	36.0	39.0	39.9	45.5	40.2	40.5	39.5	36.8	42.4	28.7	31.4	43.6	34.8	44.5	48.3	40.5	43.0
" 30	62 3	56.2	61.2	50.2	53.2	63.2	52.1	50.5	48.3	49.0	59.4	62.4	37.8	44.6	43.4	44.1	39.6	53.3	58.8	50.1	47.6	53.4	56.2	53.1	48.6	50.3	35.0	44.2	35.8	31.0	38.2	45.8	40.1	39.9	39.8	40.2	44.4	46.6	44.3	42.6	46.2	39.9	46.6	30.9	36.9	46.6	36.8	46.7	51.6	45.5	46.8
Oct. 7	56 2	56.2	58.1	58.1	59.4	53.4	56.2	51.2	39.9	49.2	40.5	52.1	38.5	50.4	46.1	46.7	44.6	56.4	61.4	52.1	52.2	59 2	48 4	53.8	49.2	54.0	36 0	45.3	36.6	34.1	40.1	46.9	41.2	45.2	41.4	39.5	48.3	51.5	50.3	50.5	49.3	44.7	50.4	35.6	37.8	48.8	30.5	50.1	58.9	48.3	48.0
" 14	54 2	54.1	58.0	58.2	61.2	62.2	43.4	49.2	40.3	48.5	43.8	48.3	30.4	42.0	39.9	42 1	40.8	52.6	60.5	53.5	48.6	52.0	39.1	52.7	54.0	56.0	35.8	46.2	34.9	34.1	42.3	50.1	39.6	46.3	40.2	39.0	49.6	54.9	56.5	51.4	48.9	48.9	51.6	39.3	42.5	39.9	29.8	51.8	59.7	49.7	47.3
" 21	52 1	54.2	57.2	56.5	54.6	58.5	41.2	48.9	38.8	48.3	44.7	48.0	30.2	41.3	38.7	41 0	40.9	53.8	61.4	50.0	48.9	48.5	38.2	48.3	49.8	51.0	33.8	41.0	34.8	34.8	43.3	52.8	38.2	50.5	39.5	35.5	48.5	59.1	38.3	48.5	44.0	51.6	56.0	42.5	40.1	31.5	27.0	48.2	48.9	39 6	45.4
" 28	51 3	52.3	48.2	52.8	52.3	56.1	42.5	47.6	38.5	49.0	37.9	38.4	28.3	42.0	35 5	39 1	38.2	51.5	58.3	48.2	40.7	39.1	35.8	40.0	48.2	58.9	32.6	38.6	30.8	36.6	38.8	45.2	39.9	48.3	38.3	28.3	45.6	49.8	32.8	38.0	41.5	54.2	38.5	40.5	38.2	30.0	25.5	38.3	40.1	40.1	42.0
Nov 4	24 8	50.1	38.0	50.1	49.2	34.4	35.8	46.1	35.7	41.5	35.5	35.5	29.4	38.2	32.4	39 2	38.5	48.2	54.6	45.3	40.0	30.2	32.1	38.4	38.5	61.7	30.0	38.2	29.5	32.1	30.2	40.3	30.5	38.2	38.3	28.3	40.6	41.3	30.2	30.5	40.3	48 3	30.6	38.3	25.4	29.8	23.0	39.5	30.0	30.8	36.7
" 11	23.9	47.7	35.1	45.1	30.1	34.2	35.3	36.1	36.2	38.5	22.1	22.4	24.7	39.1	29.9	38 0	29.4	39.5	50.6	38.6	38.4	24.5	30.4	35 1	24.6	53.3	28.1	35.5	29.6	30.8	28.1	38.9	28.1	30.5	28.8	25.6	38.7	39.6	28.8	38.7	38.9	40.0	28 5	30.3	20.1	25.0	21.3	25.8	28.4	30.0	32.8
" 18	20.1	40.8	30.2	30.8	29.8	32.0	35.0	35.7	24.2	25.5	21.5	21.0	23.8	29.7	27.8	28 5	24.1	28.7	38.0	30.8	31.5	23.1	20.5	24.6	18.5	37.1	28 9	35.0	28.7	30.0	24 6	30.1	24.5	24.9	24.3	22.8	30.5	30.8	25.1	27.7	29.5	35.5	18.9	18.0	18.2	24.1	20.1	24.0	25.9	25.6	27.2
" 25	19.9	38.2	28.1	29.8	29.6	24.5	30.5	22.4	24.5	24.6	18.3	17.1	22.7	24.6	24.6	24 3	21.0	25.8	25.4	28.5	28.4	20.2	18.4	19.2	17.4	30.2	27 6	25.4	25.3	29.5	20 5	28.3	24.0	18.0	20.2	22.0	28.7	25.2	22.1	25.0	24.3	30.2	18.2	17.5	18.4	22.4	18.9	23.0	23.3	24 3	23.9
Dec 2	19.0	30.2	25.2	24.5	23.1	22.7	26.1	21.9	23.5	23.8	18.0	17.2	21.2	23.6	23.3	23 2	19.5	24.1	23.7	19.4	23.2	18.4	16.3	18.6	17.0	30.0	24.8	24.0	24.5	24.3	19.6	20.4	20.5	18.0	18.3	19.5	26.6	22.3	18.6	24.0	18.5	25.5	13.7	10.3	17.0	20.6	18.0	20.1	22.0	20.7	21.3
" 9	18.2	30.0	25.0	23.5	22.7	22.0	20.6	20.3	10.2	28.7	38.5	24.8	23.4	23.6	21.2	22 4	19.8	26.9	18.8	18.2	20.8	18.2	18.2	16.0	10.5	25.6	20 2	21.1	21.3	22.0	18 1	18.7	18.0	16.3	16.5	18.4	20.1	20.1	18.0	21.6	17.0	15.6	12.0	9.2	15.9	18.6	16.5	18.6	20.1	16.3	19.7
" 16	24.8	40.0	38.7	26.4	23.3	24.6	24.7	28.7	12.0	48.2	51.0	40.0	50.0	38.2	27.6	34 6	29 5	30.1	21.5	25.4	25.8	30.2	28.9	19.5	12.8	15.8	20 0	10.8	21.0	8.2	17.0	16.2	16.5	25.4	14.6	16.2	20.0	25.6	21.4	23.6	18.4	15 8	17.6	18.6	23.4	24.9	24.7	25 8	26.6	18.6	24 8
" 23	39.8	66.0	56.0	35.6	60.1	40.5	27.0	46.5	40.5	49.6	45.6	46.3	51.0	50 5	48.5	54 5	42.6	51.8	40.3	37.0	40.3	39.4	38.0	29.7	22.6	19.6	15 9	12.9	28.9	25.0	20.5	34.5	24.5	36.3	36.9	31.5	31.5	37 8	36.1

plants which received the fullest sunshine, instead of being backward to the point of being almost dwarfed in aspect, grew more rapidly and seemed in all respects stronger and more thrifty than did plants which received partial shade or fairly complete shade. Before any general conclusions are safe, that is, conclusions as to the advisability of providing shade under climatic conditions which are not extreme in direction, much more work will be necessary.

It is hoped that abaca growers in places where shading is needed may appreciate the value of the study of the effects of shade on the environment of the abaca plant and on the plant itself.

I wish to express my obligation to Dr. E. B. Copeland for his helpful criticism during the progress of this study.

NOVEMBER

			Temperature.			
			On Hill		Temp. Building.	
Date	Rainfall		Maximum	Minimum	Maximum	Minimum
1	Inch.	Mm.	Degrees.	Degrees	Degrees.	Degrees
1	0		30.1	22.9	30.0	23.9
2			29.7	22.2	29.3	22.7
3	0.03	0.762	29.4	23.2	28.6	23.9
4			29.0	22.0	28.4	23.0
5			30.3	20.2	29.0	21.9
6			28.0	19.9	27.6	21.0
7			29.50	22.40	29.0	23.6
8			29.0	22.1	28.30	23.0
9			29.5	23.0	28.7	23.6
10			28.5	22.9	27.7	22.7
11			29.1	21.1	28.0	21.6
12			29.0	21.6	27.9	21.9
13			28.0	22.5	26.6	22.5
14			28.9	22.9	28.8	24.0
15			29.0	21.4	28.1	22.3
16	0.08	2.032	28.9	23.9	28.5	24.4
17			27.9	23.7	27.5	23.9
18	0.22	5.588	27.5	22.2	26.8	23.3
19	0.25	6.350	27.3	22.6	27.0	22.9
20	0.02	0.508	26.8	23.1	27.4	23.3
21	0.07	1.778	28.0	23.3	27.5	23.3
22	0.05	1.270	28.5	23.0	28.1	22.3
23			29.0	21.8	28.9	22.3
24			29.6	21.6	29.5	23.2
25			29.0	22.7	29.0	22.8
26			27.0	22.8	28.0	23.0
27			29.5	21.6	29.0	23.3
28			29.6	20.0	28.7	21.9
29			28.3	20.6	28.2	21.3
30			28.3	20.9	27.7	21.0
Totals	0 72	18.288				

The Philippine Agriculturist and Forester

Organ of the Student Body of the Philippine College of Agriculture, Published Monthly During the School-year

ENTERED AT THE POSTOFFICE AT LOS BAÑOS, LAGUNA, AS SECOND CLASS MAIL MATTER

₱ 2.00 A YEAR **25 CENTAVOS A COPY**

TORIBIO N. VIBAR, *Editor in Chief*

FELIPE CEVALLOS, ANDRES NAVARRO, *Assistant Editors*

BIENBENIDO M. GONZALEZ, *Business Manager*
FLORENCIO OLIVA, *Asst. Business Manager*

Address all communications to the Business Manager LOS BAÑOS, LAGUNA.
Foreign Subscription: 1.50 dollars a year.

COLLEGE NEWS

Assistant Professor Ledyard, after spending one year leave of absence in the States, has come to resume his classes in Zoology I and II. He is Acting Dean of this college during the time Dr. E. B. Copeland is away in the States.

Mrs. E. M. Ledyard is expected to arrive on the 15th of June. She will be in charge of the Department of Modern Languages.

Mr. Vitaliano Acorda, one of the promising members of the student body, has passed away. This is the first time since its establishment that this institution suffers the death of one of its members.

The PHILIPPINE AGRICULTURIST AND FORESTER expresses its most sincere condolence and sympathly to the family of the deceased.

For the accommodation of the new students who are expected to come next School Year several nipa houses are now under construction in the College barrio. Also a student mess hall will be built spacious enough to seat forty students at a time.

Department of Rural Engineering.

Our frontispiece represents the farm engineering class at work on the construction of a cement floor for a model poultry house. Students learn by actual labor how to use concrete for making fence posts, floors, "arigues" and culverts. They are required to make out regular requisitions for materials for the construction of various farm buildings. Plans are drawn of these buildings and lectures are given regarding location, sanitation, and water supply. Lectures and practical work are given on farm machinery and road building.

During the first semester of the college year the students are taught irrigation and drainage, with attention to the measurement, control, and duty of water and the demands of different soils and crops.

Chemistry Department

Francisco Quisumbing, Nemesio Mendiola, Francisco Marquez, and Florencio Oliva received the highest credit in Chemistry I last year. As was previously announced in this magazine these are entitled to prizes of five pesos each, but the last named was excluded from competition because of unexcused absences. One of the prizes was divided equally between José Tirona, Rafael Espino and Gerardo Ocfemia.

January 12, 1912.

THE PRESIDENT,
University of the Philippines,
Manila, P. I.

SIR:—

I have the honor to report as follows on my recent trip to the Sarangani district:—

At the suggestion of the governor of the Moro Province, Brigadier General Pershing, instead of proceeding directly to Makar, which could have been arranged, I went first to Davao and returned thence to Nakar on the military launch "New Orleans", accompanied by Captain Boyle, P. S., whom General Pershing sent with me as a guide and escort. Captain Boyle was recently in command of a scout Post at Makar, and his acquaintance with the district made it possible for me to accomplish more, in the day and a half left available than I would have been likely to get done in a number of days without him.

We reached the Makar anchorage about noon, December 7. The barracks have been abandoned as a military post, but all of the buildings except one are standing. There is a small, clear stream on the left or west of the post, which was used as a water supply. This is said to rise from springs not far back of the coast. Immediately east of the post is a river which drains the southwest slope of Mt. Matutum, and the east end of the chain of coasta-mountains lying to the west. Where we forded this river a little above its mouth, the flow was fully 3000 second-liters, and possibly twice this amount. The stream was somewhat muddy both times that I crossed it, but was said by Captain Boyle to be lower than at any time while he was stationed at Makar.

We crossed this river near the mouth to a small coconut grove. Thence we walked straight north toward the mountain for six or seven kilometers to a creek, in a gulch 15 meters deep. Up to this point, we might have been in the San Joaquin valley so far as the general character of the vegetation was concerned. Near the coast, there are scattered buri palms, but further back nothing but grass, and this not thick. It is burned over at least twice a year. After crossing this creek, we walked gradually more to the west, finally aiming toward the pass to the west of Matutum instead of toward the mountain itself. A kilometer above the creek crossing, the grass begins to be denser and greener, and in another kilometer or two the country becomes a dense meadow with occasional trees in the depressions. Probably about 14 kilometers from the coast is a front line of low hills which are the only real break in the even slope which extend from Makar back to the forest on the mountain. This forest begins at an altitude of approximately 800 meters, and at a distance of probably 30 kilometers from the coast.

As we were not going directly toward the mountain, it was dark when we reached these hills. The moon was up soon after sunset so that we continued to march, but progress was slow because of the collapse of some of the scouts. We crossed two creeks flowing through woods and reached the place of Tambuto, the Sultan of Talik, at 9:30. He and most of his people were in higher country attending to the harvest, or rather the collection, of rice. The rice seems to be raised mostly by Bilanes, and how the Moros acquired it was not made very clear. A rider went out after the Sultan, who was waiting to see us in the morning.

The country about the Sultan's place is very much like that from Nagkarlang to Lukban, except that it is much less broken. There is a big stream just below the Sultan's in a valley 15 or 20 meters below the general level, but the small creeks, which are numerous, are only 2 to 4 meters below their banks. All of this

drainage reaches the sea at Makar. Where it is not kept in grass by fire, the country about the Sultan's is the densest kind of a jungle, but it has all been in cultivation recently enough so that there are very few large trees.

From the Sultan's, Captain Boyle and I, with two scouts, continued up the trail toward lake Buloan for an hour, and were then again in the grass country. We left the trail and went back toward Matutum for possibly a kilometer, and then found a trail which is said, and doubtless correctly, to lead down to Sarangani Bay at the place of Sheriff Mukson, an hour's walk east of Makar. We followed this trail, walking reasonably fast, for four hours, and then reached the gorge of the only stream it crosses, the same which we had crossed lower down the day before. We then walked directly, through the grass country, to the trail by which we had ascended, and reached the creek crossing at 3:30. After a rest here, we returned by the trail used the day before, getting back to the New Orleans about dark.

The limited time at my disposal did not permit me to examine the country to the northeast of Sarangani Bay where there is said to be an extended area of fine and easily tillable land, nor that directly west of the bay which is in grass and evidently decidedly dry. The country to the north and northwest of the bay which I was able to traverse is characteristically a grass country, but with wooded flats along the streams. From the bay directly toward the mountain, the width of this grass land is about 30 kilometers. East and west along the foot of the forest, the length of the grass country is at least 20 kilometers. This entire area may well be regarded as made up of two parts separated by the line of low hills already mentioned. Above these hills, the area in grass or with only scattering trees can not be less than 150 square kilometers and may be considerably more than this. This entire savanna is burned over every year and perhaps oftener than this. How completely the absence of trees is due to fire and how much it may be due to the soil, it is impossible to say. It is my opinion that without fire it would all be in forest.

The time of our visit is said by Captain Boyle to be the height of the local dry season, and the aspect of the country near the coast would lead me to believe that it is fully as dry as it ever gets. In spite of this season, all of this upper country, except where fires have been so recent that the ground is still black, is very densely covered with rich, green grass made up in very large part of succulent species. I picked up along the trail specimens of Panicum indicum, P. villosum, and Setaria flava, all of which are desirable forage grasses even in comparison with what are regarded as good pasture grasses in other countries. The commonest single grass is *Thmaeda triandra*. This grass is by no means as nutritious as the three just mentioned, but is still a desirable component of Philippine pastures. It appears in two forms. The least common is the fruiting condition. After fruiting, the grass proliferates freely, and keeps up a succession of very numerous young leaves. While this proliferation is active and it was very much so at the time of my visit, it makes a very good pasture. If it does this during the dryest season, there need hardly be any fear as to other times. There are also to be found here a number of species of coarser and practically useless grasses, but none of these are very abundant and none of them cover much ground. Cogon and talahib, the least desirable but most abundant grasses in most of the Philippine waste lands were both present, but neither is bundant enough to be regarded as a nuisance. A number of other

plants found in this savanna indicate that the climate is at all times moist enough to guarantee luxuriant growth. Among these are two sedges, one of which is regularly to be found in the limited really good pastures of the Philippines. Another common plant is the fern *Dryopteris cucullata* which is to be found elsewhere with succulent grasses, and only in such places.

The woods around the springs and the scattered trees elsewhere provide what shade is needed. The climate is not hot. There is then absolutely no question that so far as the forage is concerned this entire area must be regarded as a very rich pasture. It is rich not only in comparison with ordinary Philippine conditions, but, since it is luxuriant throughout the year, it would be able to support an amount of stock which wuld be impossible on most equal areas in temperate countries. On the other hand, it is not well watered. The country is the slope at the foot of a volcano, and is very porous so that the water which falls on it and on the mountain above it moves toward the sea instead of on the ground. Flowing water is to be found in one stream near the end of the savanna and in springs surrounded by woods along the lower border of the western half of it.

While the suitability of this land to use as a range is without question, and while the scarcity of other good range lands in the Philippines makes its use for such a purpose very promising. I can not believe that this is the best use to which it could be put. Land which will produce such a growth of succulent herbage as is found here ought to be in cultivation. Except that the ground is less broken, this country is for tropical agricultural purposes identical with the north slope from Mt. Banahao. This slope in Laguna is likewise broken by low hills, just back of Magdalena. From the hills back to the mountain forest, the climate and soil, so far as the vegetation indicates, are practically identical in the two places. And the vegetation is a sure guide; for it is merely the luxuriance of the vegetation which still decides whether the locality is good or bad when the land is cultivated. The Laguna plain is geologically older than the Sarangani one. It is therefore more broken, and the water courses have been worn deeply enough so that the spring line has moved much closer to the mountain. But the water in these streams in Laguna is just as useless and just as unnecessary for the production of any crop except rice as is the water which flows under ground from Mount Matutum.

The coconut zone from San Pablo to Majayjay is at the same altitude as the larger part of this savanna. It is situated on the same kind of porous soil where one may walk along the trails in a moderately heavy rain without getting his feet muddy. It is at the present time the richest district in the Philippines. It produces chiefly coconuts because a small population with ample land can get bigger returns from coconuts than from any other of the great tropical crops. It raises almost all kinds of tropical fruit in more profusion than they are found in most parts of the islands. It raises the vegetables of the tropics, and many of those of temperate countries, to perfection. So far as there is any significant difference in the wild vegetation of the two places, we may regard the Sarangani plain as the better of the two; and beside this the latter is not subject to devastation by typhoons. The only place in this upland district where there are any coconuts planted is about the house of the Sultan of Talik. This sultan was driven from the Cotabato valley by Piang and Ali a few years ago. His coconut trees were planted four years ago and have had no care. Under the circumstances, they have done very well; fully as well as young trees treated in the same way will do in San Pablo and Nagkarlang. I would

myself not hesitate about planting coconuts on the largest scale in this country, nor about recommending any body else to do the same.

To turn now to the country lying below the line of small hills already mentioned, it is to be understood first that these do not mark a sharp break in the vegetation, but that for at least 4 kilometers further toward the coast the conditions are very much the same as in the land higher up. The ground water must be nearer the surface, and irrigation would be easier because of the lower level, but for most purposes neither the stock grower nor the planter would have to concern himself with artificial sources of water. This additional land which would provide pasture at all seasons and could be made to support crops amounts probably to more than sixty square kilometers or enough land for 600,000 coconuts with the widest advisable spacing.

Going further toward the coast, the country found is, as already stated, so dry during a part of the year that little green herbage persists. Captain Boyle states that at the time he was stationed in Makar, the part of this plain which we crossed was entirely green. It might therefore be used as a range during a part of the year, the stock being driven further east on the north for the dry season; but so long as there is pasture at all seasons available on a large scale in the neighborhood, it is not worth while to consider the use for this purpose of land which is at times unsuitable. The soil here is ir, regular in depth, but in large part is as deep as is a matter of interest to the farmer. I have no doubt that with water it would prove fertile; and with sufficient water furnished by irrigation, the long spells of dry and sunny weather would be a very valuable agricultural asset.

In all parts of the world, and with all crops except the most sensitive, the biggest yields are obtained in the sunniest and dryest places as soon as there is a sufficient artificial supply of water. This is not merely because irrigation is more certain than the weather, but still more because the cloudiness and the atmospheric humidity which must be found where there is any considerable amount of rain are in themselves unfavorable to the most active development of the majority of cultivated plants. In the case of the coconut, unbroken sunshine and dry air are ideal conditions so long as the roots are able to secure all the water the trees need. It is therefore not open to doubt that with adequate irrigation, the coastal part of this plain would produce larger crops of coconuts than the country higher up.

The water in the Makar river is sufficient to irrigate 3,000 hektares of rice, or several times this area in most other crops. The contour of the land is such that it would be a very simple engineering proposition to cover any part of this plain from the river. It does not follow that it would pay to do this. The soil is so porous that ditches would almost certainly have to be lined. Large capital willing to wait for returns could plant this lower plain to coconuts with absolute certainty that in time it would secure a very large return, but it is not an attractive place for small or unstable investments.

As already stated the country to the northeast of the bay is reported to me to be extensive, easily worked, and less dry. The country to the west of the bay would be easily worked, but is dryer than that I visited. Here too, it will take irrigation to make any development practicable, The mountains above this part of the plain seem to have ample water for this purpose.

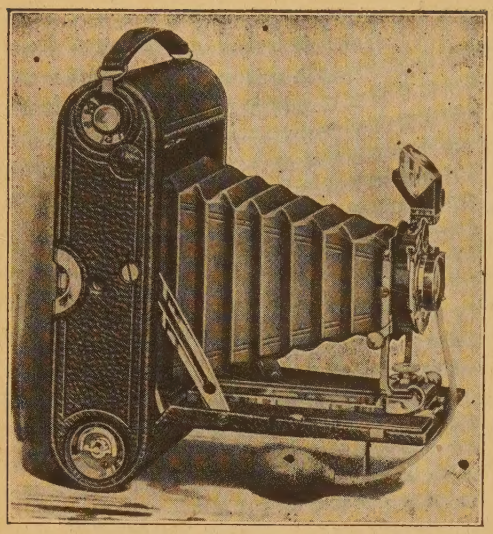
In conclusion, I will say that the land from Sarangani bay back to Mt. Matutum offers more promise of very profitable agricultural development than any large area known to me north of the Moro

Province. In southern Mindanao itself, I know of only one other location comparable to this in natural promise. That this Sarangani district is a fine natural range, is certain and has been understood before this time. It is no less adapted to crop production, and in the course of time will certainly be used in this way. Proper judgment being exercised in the selection of kinds, the most of it will make good rubber country; but under present conditions, labor not being abundant, I would rather advise the extensive planting of coconuts. Without resorting to irrigation, there is room here for more than 2,000,000 trees.

Sarangani will be practically on one of the world's commercial higways before coconuts planted now can come into bearing. Taking this fact and the local advantages into joint consideration, I consider this a place for settlement and investment to offer unrivalled promise.

I take pleasure in acknowledging my obligation to Brigadier General Pershing for helpful suggestions, for placing the launch "New Orleans" at my disposal, and for providing me with an escort. Without this help and the local knowledge of Captain Boyle, it would have been impossible for me to pass a competent judgment on this district without the use of more time than was at my disposal.

E. B. COPELAND,
Dean, College of Agriculture.



Satisfaction

Photo Supply Co.

Eastman's Kodaks in all styles and sizes;

Eastman's Films; Velox; and Arturo papers and Post Cards; Cramer, Seed, Standard Ilford dry plates; Extensive line of Accessories; Card Mounts, Photo Albums.

PICTURE FRAMING

Developing and Printing the very best. Unexcelled mail order system. Trade at the Busy Store

145-147 ESCOLTA **PHOTO SUPPLY CO.** P. O. BOX 594

FERTILIZERS

WE SELL THE MOST *COMPLETE FERTILIZERS*

WHICH INSURE THE *BEST RESULTS*

IN USE BY THE BIGGEST *SUGAR CANE* and *TOBACCO* Plantations in *JAVA* and *SUMATRA.*

GUANO PARA- ZACATE.

Unicos Importadores
KERKHOVEN & Co.
89 ANLOAGUE.

SPECIALTIES:

Sugar Cane
Tobacco
Coffee
Banana and Cocoa
Manures

All Fertilizers Are Made According to *Analyses* of the *Soil*